Neurobehavioral Effects of the Carbamate Insecticide, Carbaryl, on Salmonids

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Willapa Bay is a coastal estuary in Washington State that provides habitat for cutthroat trout (Onchorhynchus clarki clarki) as well as other salmonids. Cutthroat trout forage throughout the estuary in the summer months when carbaryl, a carbamate insecticide, is applied to oyster beds at low tide to control burrowing shrimp populations. On the day of spray, carbaryl has been measured in the estuarine water column at concentrations >1,000 ppb. Carbaryl is a neurotoxicant that inhibits acetylcholinesterase, an enzyme that hydrolyzes the transmitter acetylcholine at neuronal and neuromuscular synapses. Previous studies determined that cutthroat trout do not show an olfactory response to carbaryl, do not avoid carbaryl-containing water, and that short-term (6 hour) carbaryl exposure rapidly (< 2 hrs) depresses brain and muscle acetylcholinesterase activity in a dose-dependent manner (IC50s of 213 ppb and 185 ppb, respectively) for approximately two days. The goals of this study were to determine the impacts of carbaryl exposure on the swimming behavior of cutthroat trout as well as their vulnerability to predation. Results indicate that salmonids' swimming performance and ability to avoid predation are significantly affected at carbaryl concentrations >=750 ppb and >=500 ppb, respectively.